What is claimed is:

1. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer;

a first ferromagnetic material layer of the BCC structure formed on a first side of said tunnel barrier layer; and

a second ferromagnetic material layer of the BCC structure formed on a second side of said tunnel barrier layer, wherein

said tunnel barrier layer is formed by a single-crystalline MgO_x (001) layer or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

2. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer comprising MgO(001);

a first ferromagnetic material layer comprising Fe(001) formed on a first side on said tunnel barrier layer; and

a second ferromagnetic material layer comprising Fe(001) formed on a second side on said tunnel barrier layer, wherein

said MgO(001) layer is formed by a single-crystal MgO_x (001) layer or a poly-crystal MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

3. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer comprising MgO(001);

a first ferromagnetic material layer formed on a first side of said tunnel barrier layer and comprising a single-crystalline (001) layer or a poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said polycrystalline layer having the (001) crystal plane preferentially oriented therein;

a second ferromagnetic material layer formed on a second side of said tunnel barrier layer and comprising a single-crystalline (001) layer or a poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said polycrystalline layer having the (001) crystal plane preferentially oriented therein, wherein

said tunnel barrier layer is formed by a single-crystalline MgO_x (001) layer or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented, wherein

the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

4. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer;

a first ferromagnetic material layer of the BCC structure formed on a first side of said tunnel barrier layer;

a second ferromagnetic material layer of the BCC structure formed on a second side of said tunnel barrier layer, wherein

said tunnel barrier layer is formed by a single-crystalline MgO (001) layer or

a poly-crystalline MgO layer in which the (001) crystal plane is preferentially oriented, wherein

the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

5. The magnetoresistive device according to claim 3 or 4, wherein said discontinuous value is in the range of 0.2 to 0.5 eV.

6. The magnetoresistive device according to claim 3 or 4, wherein said discontinuous value is in the range of 0.10 to 0.85 eV.

7. A memory device comprising:

a transistor; and

the magnetoresistive device according to any one of claims 1 to 6, wherein said magnetoresistive device is used as a load for said transistor.

8. A method of manufacturing a magnetoresistive device comprising:

preparing a substrate;

depositing a first single-crystalline (001) layer or a first poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein;

depositing a tunnel barrier layer on said first (001) layer of Fe or an Fe alloy of the BCC structure under high vacuum, said tunnel barrier layer comprising a

single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and

forming a second single-crystalline (001) layer or a second poly-crystalline layer of Fe or an Fe alloy of the BCC structure on said tunnel barrier layer, said polycrystalline layer having the (001) crystal plane preferentially oriented therein.

9. A method of manufacturing a magnetoresistive device comprising:

a first step of preparing a substrate comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented;

a second step of depositing a first single-crystalline (001) layer or a first poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said polycrystalline layer having the (001) crystal plane preferentially oriented therein, and then carrying out an anneal process for crystallization;

a third step of depositing a tunnel barrier layer on said first (001) layer of Fe or an Fe alloy of the BCC structure under high vacuum, said tunnel barrier layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and

a fourth step of forming a second single-crystalline (001) layer or a second poly-crystalline layer of Fe or an Fe alloy of the BCC structure on said tunnel barrier layer, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein.

10. The method of manufacturing the magnetoresistive device according to claim 8 or 9, further comprising the step of causing a seed layer to be grown between said first

and said second steps, said seed layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented.

11. The method of manufacturing the magnetoresistive device according to claim 8 or 9, wherein the step of forming said tunnel barrier layer comprising said single-crystalline MgO_x (001) or said polycrystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented further comprises the step of adjusting the value of x in MgO_x.

12. A method of manufacturing a magnetoresistive device comprising:

preparing a substrate;

depositing a first single-crystalline (001) layer or a first poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein;

forming an amorphous MgO layer on said first (001) layer of Fe or an Fe alloy of the BCC structure and then crystallizing said amorphous MgO layer by annealing so as to form a tunnel barrier layer comprising the single-crystalline MgO_x (001) or the poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and

forming a second single-crystalline (001) layer or a second poly-crystalline layer of Fe or an Fe alloy of the BCC structure on said tunnel barrier layer, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein.

13. The method of manufacturing the magnetoresistive device according to claim 12,

wherein said amorphous MgO layer is deposited by sputtering, using a target with the value of x in MgO_x adjusted.

14. The method of manufacturing the magnetoresistive device according to claim 12, wherein the step of forming said amorphous MgO comprises the step of adjusting the value of x in MgO_x.

15. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer;

a first ferromagnetic material layer formed on a first side of said tunnel barrier layer and comprising an amorphous magnetic alloy; and

a second ferromagnetic material layer formed on a second side of said tunnel barrier layer and comprising an amorphous magnetic alloy, wherein

said tunnel barrier layer is formed by a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

16. The magnetoresistive device according to claim 15, wherein the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

17. A magnetoresistive device comprising a magnetic tunnel junction structure

comprising:

a tunnel barrier layer;

a first ferromagnetic material layer formed on a first side of said tunnel barrier layer and comprising an amorphous magnetic alloy; and

a second ferromagnetic material layer formed on a second side of said tunnel barrier layer and comprising an amorphous magnetic alloy, wherein

said tunnel barrier layer is formed by a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented, and wherein

the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

18. The magnetoresistive device according to claim 16 or 17, wherein said discontinuous value is in the range of 0.2 to 0.5 eV.

19. The magnetoresistive device according to claim 16 or 17, wherein said discontinuous value is in the range of 0.10 to 0.85 eV.

20. A memory device comprising:

a transistor; and

the magnetoresistive device according to any one of claims 15 to 19, wherein said magnetoresistive device is used as a load for said transistor.

21. A method of manufacturing a magnetoresistive device comprising:

preparing a substrate;

depositing a first ferromagnetic material layer comprising an amorphous magnetic alloy on said substrate;

forming an amorphous MgO layer on said first ferromagnetic material layer and then crystallizing said amorphous MgO layer by annealing so as to form a tunnel barrier layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and

depositing a second ferromagnetic material layer comprising an amorphous magnetic alloy on said tunnel barrier layer.

22. The method of manufacturing the magnetoresistive device according to claim 21, wherein the step of forming said tunnel barrier layer comprising said single-crystalline MgO_x (001) or said poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented involves deposition by sputtering using a target with the value of x in MgO_x adjusted.